



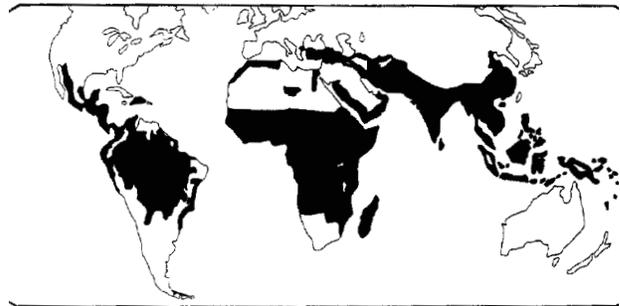
## Human Malaria<sup>1</sup>

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Malaria in humans is a disease transmitted mosquitoes in the genus **Anopheles** and by any one of four species of microscopic protozoan parasites in the genus *Plasmodium* (*P. vivax*, *P. falciparum*, *P. malariae* and *P. ovale*) distributed throughout the world.

Human malaria was endemic in the United States in the 19th and 20th centuries. It was eradicated from the U.S. by mid-1950. From 1957 through 1996, 78 human cases of introduced malaria (documented cases acquired by mosquito transmission from imported cases) caused by all four types of malarial parasites were been reported from 22 states (Emerging Infectious Diseases 2: 357-343, 1996; MMWR 46:264-267,1997). Most of these cases (63) were due to *P. vivax*. Three of these cases were in Florida, one in a woman camping in the panhandle's Gulf County in 1990 and two in men living in Palm Beach County in 1996. These patients had never lived in or visited a malarious area. These introduced infections in Florida are the first since 1948 when human malaria was eradicated from Florida.

Although malaria disappeared as a significant problem in the U.S. by the mid-1950s, it is still one of the most important communicable diseases on a worldwide basis (Figure 1). There were 300- 500 million cases worldwide in 1996; 1.5- 2.7 million were fatal (Nature, London. 386: 535-536, 1996).



**Figure 1** Distribution of malaria.

Up to now, the only potential of malaria transmission in Florida stems from people who have relapses, or cases recently acquired in foreign countries where malaria is common. The former is referred to as introduced malaria. Despite the widespread presence of *Anopheles* mosquitoes in the US, a highly susceptible human population, and of thousands of cases of acquired malaria, there are relatively few cases reported in the US each year, and very few of those were actually infected in the US.

The CDC Annual Summary of Malaria for 1996 (January 3, 1997) reports a total of 1,542 malaria cases in the U.S. (Figure 2). This compares to 1,419 cases reported in the U.S. in 1995. In 80 cases of malaria reported in Florida, all but two were acquired outside the US.

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**Figure 2.** Geographic distribution of malaria cases in the U.S. (1995).

The largest outbreak of introduced malaria since 1952 occurred in California when, from 1980 through 1990, there were 13 outbreaks in California. During one outbreak in Carlsbad, California, in 1986, 28 cases of *P. vivax* occurred in Mexican migrant workers in a 3-month period, and 2 were in local residents who had no apparent malaria risk factors.

Clinical symptoms may start with headache, aching in the bones, anorexia and sometimes vomiting. One may feel like the flu is coming on. This is followed by chills, teeth chattering and then sensations of great heat with high fever and sweating, usually in a repeating cycle. If you experience these symptoms and have been in an area where malaria was reported, see your doctor immediately. Malaria can be treated effectively, particularly in the early stages.

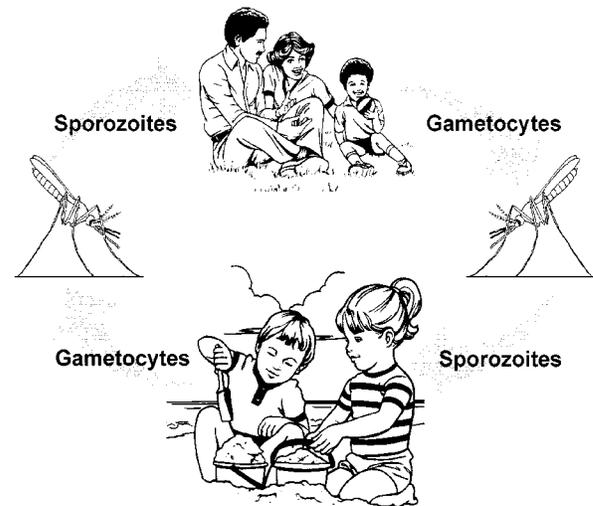
Clinically, malaria infections vary from moderately severe to fatal illness, depending on the species of parasite, the human's condition, and how soon the patient receives treatment. Malaria caused by *P. falciparum* is particularly severe and often fatal in infants and young children; *P. vivax* generally is less severe and has a lower mortality rate. Persons may be infected over and over again, usually developing a tolerance for the parasite which prevents severe illness from reoccurring.

If insufficiently treated, a malaria infection may persist in a person for many months or years and have a continuing or periodically renewed ability to infect mosquitoes, often in the absence of symptoms or with a less severe illness. For *P. vivax* and *P. ovale*

parasites may persist in the liver cells for years and give rise to relapses of the disease by reinvading the red cells during times of stress.

## How Malaria Is Transmitted By Mosquitoes

The parasite is transmitted from person to person by the bite of *Anopheles* mosquitoes, and ONLY *Anopheles* mosquitoes (Figure 3). The malaria parasite inhabits the human red blood cells, where it multiplies asexually. After reaching maturity in 48-72 hours, the red blood cells burst and release large numbers of new parasites, most of which enter new red blood cells, thus, reinitiating the cycle. Others enter liver cells. Before the asexual cycle in red cells is established, the parasite must complete a 5-10 day period of multiplication in liver cells. The typical malaria symptoms, chills and fever, are associated with this rupturing of infected red, cells.

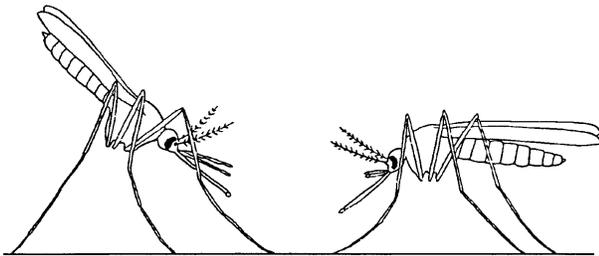


**Figure 3.** How malaria is transmitted. (Adapted from CDC, 1989).

In addition to these asexual forms in humans, some of the parasites develop into sexual forms: the male and female gametocytes. Infection of the mosquito takes place when an *Anopheles* female feeds on an infected person who is carrying gametocytes. The parasite then undergoes a sexual cycle in the mosquito for the next 7-20 days. Numerous microscopic, spindle-shaped forms, known as sporozoites, then invade the mosquito salivary glands. The human infection is initiated when sporozoites are injected during the bite of the infected mosquito.

## Florida's *Anopheles* Mosquitoes

Of the 70 plus species of mosquitoes occurring in Florida, 13 are in the genus *Anopheles*. It is easy to recognize adult *Anopheles* by the way they rest on a flat surface, like the skin. Unlike mosquitoes of other genera, *Anopheles* rest with their heads pointed downward and their bodies slanted at a steep angle upward (Figure 4). Other mosquitoes hold their bodies parallel to the resting surface. *Anopheles* adults also have three long mouth parts protruding from the head; other mosquitoes have one long and two short mouth parts. The immature stages of *Anopheles* are not easily recognized in the water as the larvae lie near the surface and are easily confused with floating debris.



**Figure 4.** *Anopheles* female on the left, a non-*Anopheles* female on the right.

While all *Anopheles* may be able to transmit malaria, historically, those belonging to the *Anopheles quadrimaculatus* complex of 5 species are considered the important carriers of the disease in the eastern US.

*Anopheles quadrimaculatus* adults are dark with four spots on each wing. They typically breed in

permanent bodies of fresh water containing emergent or floating vegetation. The eggs are laid singly on the surface and breeding is continuous if temperatures permit. During cold periods, adult females hibernate in protected sites. They feed primarily on large mammals, including humans, mostly at dusk and during the night. They typically do not fly more than four miles from their breeding sites. Although species of this complex are most abundant in the northern and Panhandle sections of the state, one or more species probably occur in all Florida counties.

## Avoiding Malaria Mosquitoes

To avoid the risk of malaria, avoid mosquito bites - it is that simple. Humans cannot get malaria from wild animals, domestic animals or pets. Transmission of malaria from human to human is accomplished by *Anopheles* mosquitoes or by reuse of needles contaminated with the blood of an infected person.

Avoid mosquito bites by staying out of mosquito infested areas, securing window screens and by applying a repellent containing DEET. Most repellents on today's market contain DEET. **DO NOT OVER-APPLY DEET-containing repellent**, as this may cause side effects. Some adults have skin reactions to overexposure to DEET, and, in rare cases, children dosed heavily have experienced serious neurological problems, including slurred speech, confusion, seizures and comas. Misapplication of DEET can lead to symptoms similar to malaria and the result could be worse than malaria. **PLEASE USE DEET WITH CAUTION.**